CLAIMS

[1] A plasma etching method of performing plasma etching to an object made of silicon in a treatment chamber, said plasma etching method comprising:

introducing, into the treatment chamber, etching gas which includes fluorine compound gas and rare gas; and etching the object by energizing the etching gas into plasma state.

[2] The plasma etching method according to Claim 1,

wherein the etching gas further includes one of oxygen (O_2) gas, carbon monoxide (CO) gas, and carbon dioxide (CO_2) gas, and

the fluorine compound gas is sulfur hexafluoride (SF_6) gas.

[3] The plasma etching method according to Claim 2,

wherein the rare gas is helium (He) gas.

[4] The plasma etching method according to Claim 3,

wherein a volume of the helium (He) gas introduced into the treatment chamber is equal to or more than 30% of a total flow rate of the etching gas.

[5] The plasma etching method according to Claim 4,

wherein an inside wall of the treatment chamber is made of an insulating material.

[6] The plasma etching method according to Claim 5,

wherein the insulating material is one of quartz, alumina, an aluminum matrix with alumite treatment, yttrium oxide, silicon carbide, and aluminum nitride.

[7] The plasma etching method according to Claim 2,

wherein the etching gas further includes chlorine (Cl_2) gas.

[8] The plasma etching method according to Claim 7,

wherein a volume of the chlorine (Cl_2) gas introduced into the treatment chamber is equal to or less than 10% of a total flow rate of the etching gas.

[9] The plasma etching method according to Claim 1,

wherein the fluorine compound gas is one of sulfur hexafluoride (SF_6) gas and nitrogen trifluoride (NF_3) gas,

and in said energizing into plasma state, electricity having a frequency that is equal to or more than 27 MHz is supplied to the etching gas.

[10] The plasma etching method according to Claim 9,

wherein the rare gas is helium (He) gas, and

a volume of the helium (He) gas introduced into the treatment chamber is equal to or more than 80% of a total flow rate of the etching gas.

[11] The plasma etching method according to Claim 1,

wherein the etching gas further includes polymer forming gas, and

the fluorine compound is sulfur hexafluoride (SF_6) gas.

[12] The plasma etching method according to Claim 11,

wherein the polymer forming gas is one of octafluorocyclobutane (C_4F_8) gas, trifluoromethane (CHF_3) gas, octafluorocyclopentene (C_5F_8) gas, and hexafluorobutadiene (C_4F_6) gas.

[13] The plasma etching method according to Claim 1,

wherein the fluorine compound gas is sulfur hexafluoride (SF_6) gas,

and in said energizing into plasma state, electricity having a frequency of 500 kHz is supplied to the etching gas.

[14] The plasma etching method according to Claim 1, comprising

etching the object by using etching gas which includes one of oxygen (O_2) gas, carbon monoxide (CO) gas, and carbon dioxide (CO_2) gas, and uses sulfur hexafluoride (SF_6) gas as the fluorine compound gas; and then further etching the object by using etching gas which includes polymer forming gas and uses sulfur hexafluoride (SF_6) gas as the fluorine compound gas.

[15] The plasma etching method according to Claim 1,

wherein the fluorine compound gas is tetrafluoroethane (CF_4) gas.

[16] The plasma etching method according to Claim 15,

wherein the rare gas is Ar gas.

[17] The plasma etching method according to Claim 16,

wherein a volume of the Ar gas introduced into the treatment chamber is 50% to 90% of a total flow rate of the etching gas.

[18] The plasma etching method according to Claim 1,

wherein the etching gas is energized into plasma state by an inductively coupled plasma (ICP) method.

[19] A device which etches a silicon substrate,

said device forming a trench in the silicon substrate using the plasma etching method according to Claim 1.